



FIG. 2

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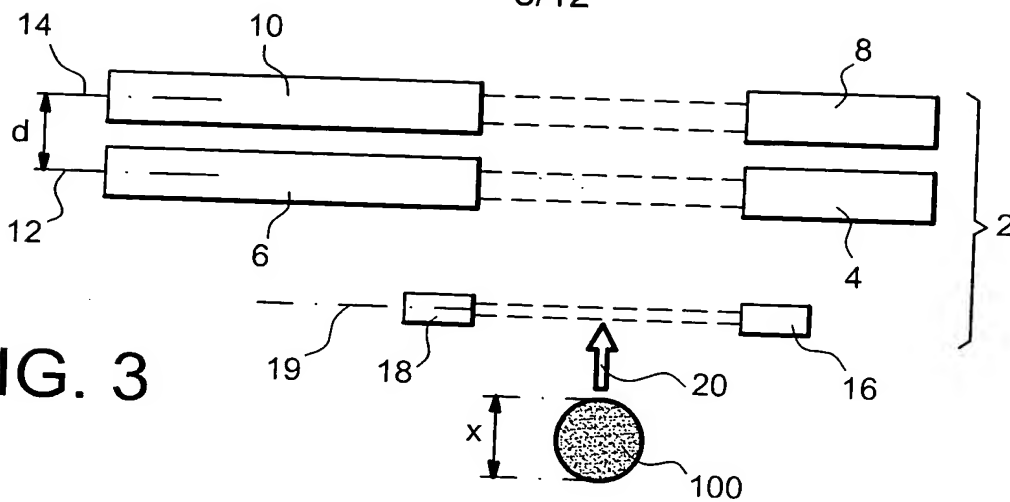


FIG. 3

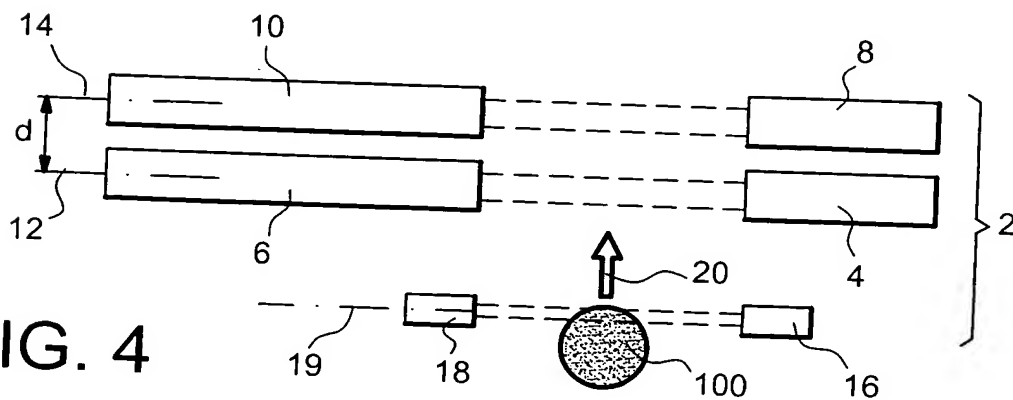


FIG. 4

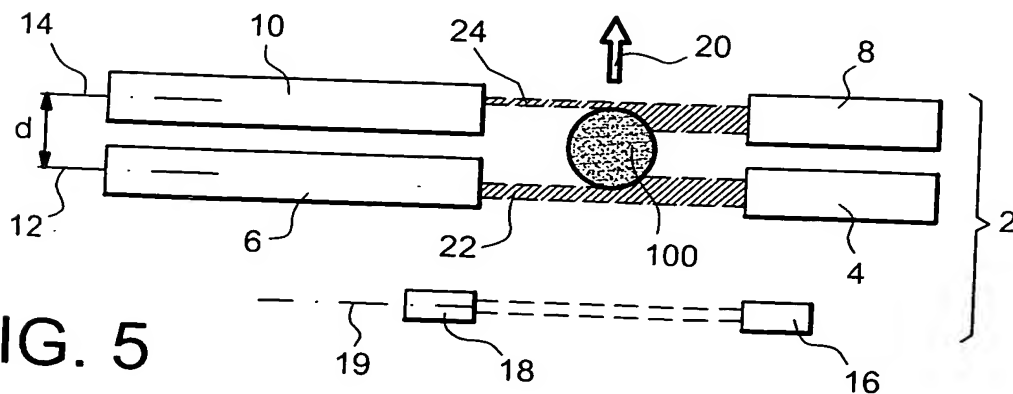


FIG. 5

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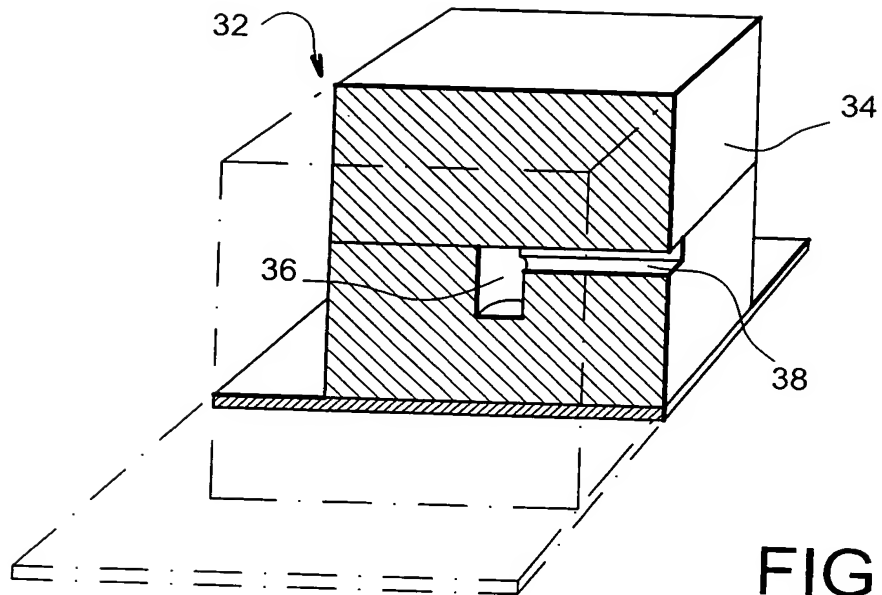


FIG. 6

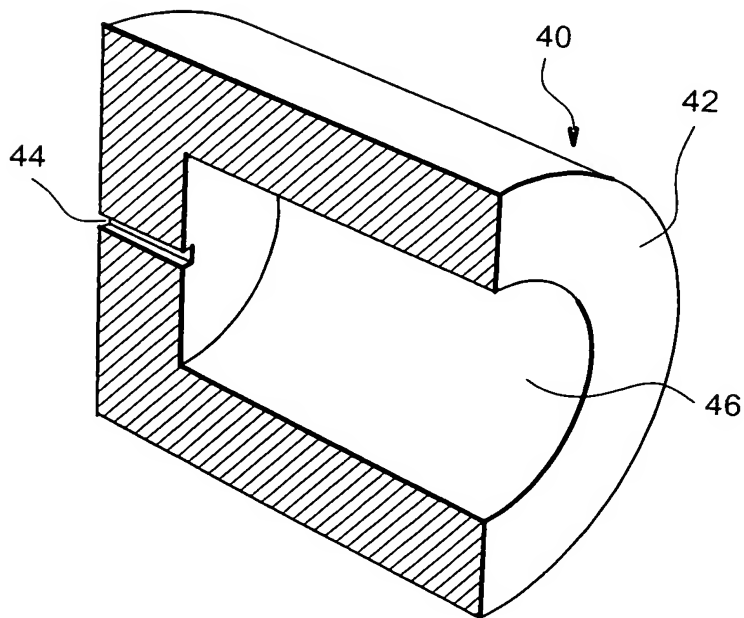


FIG. 7

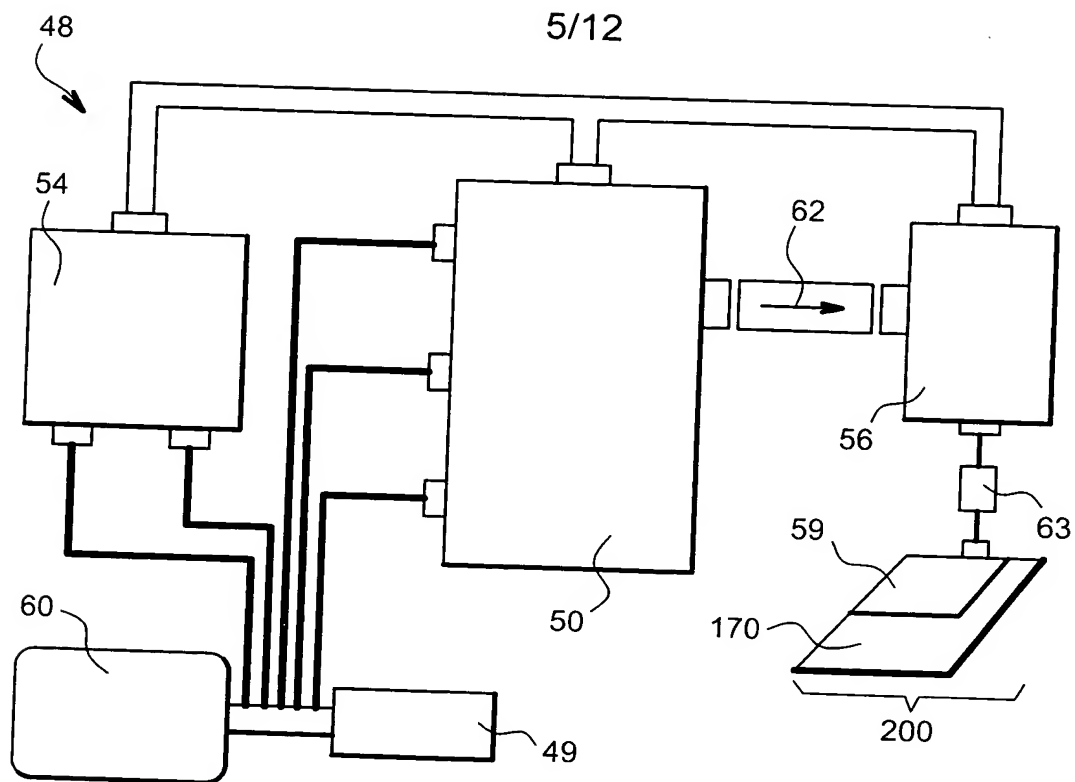


FIG. 8

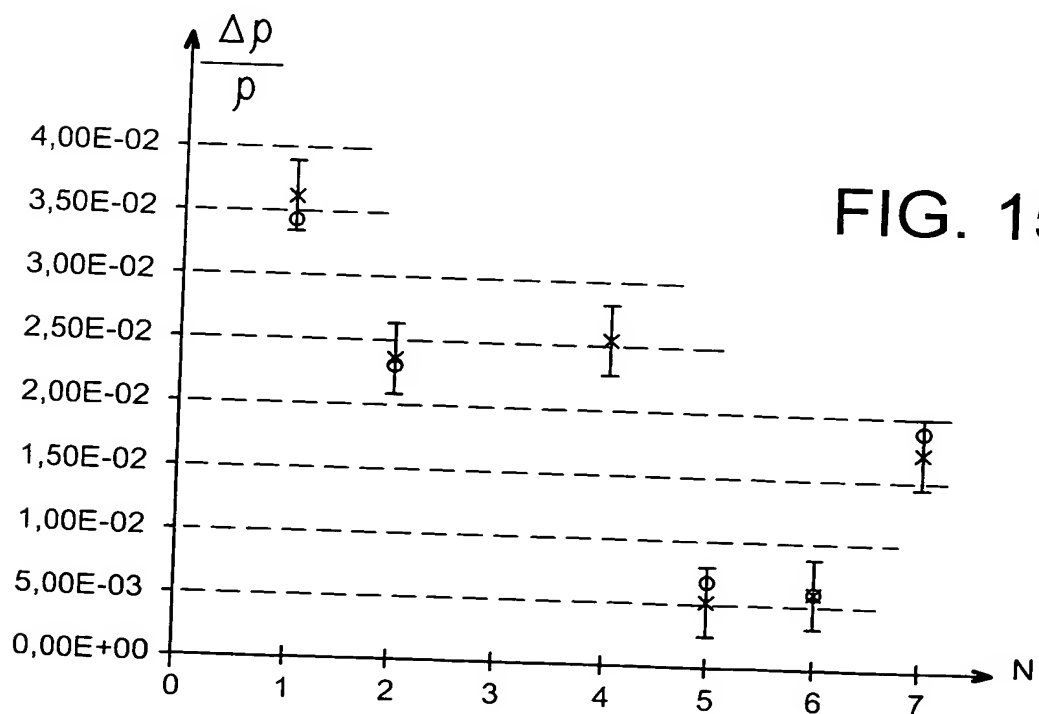


FIG. 15

PRELIMINARY CALIBRATIONS

Step 1

calibrate the position of the two infrared assemblies of the apparatus to determine the significant dimension of the object

Step 2

calibrate the position of the irradiation support of the apparatus to determine the intensity of the photon beam attenuated by passing through the object

Step 3

calibrate the measurement of the source - detector assembly of the apparatus to determine the intensity of the photon beam attenuated by passing through the object.

FIGURE 9A

**ACTUAL DETERMINATION OF THE
RELATIVE VARIATION OF THE DENSITY**

Step 4
determine the significant dimension of the object to be tested

Step 5
transport the object to the irradiation support

Step 6
adjust the position of the object by adjusting the position
of the irradiation support with respect to a source and an
associated detector

Step 7
determine the attenuated intensity of the photon beam
transmitted through the object

Step 8
acquisition, processing and analysis of the spectrum obtained

Step 9
determine the relative variation of the density of the object
with respect to the density of one or several objects with
standard density

Step 10
return transport of the object to its location on the turntable.

FIGURE 9B

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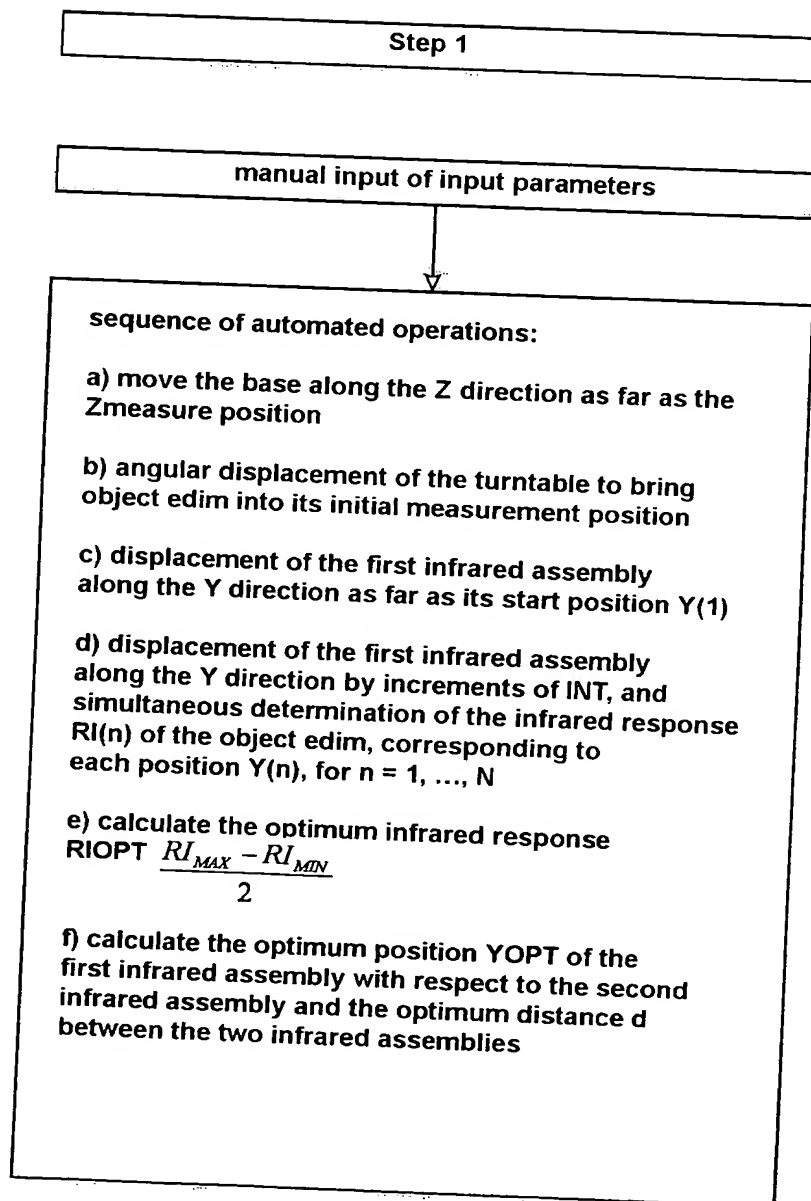


FIGURE 10

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Step 2

manual input of input parameters

sequence of automated operations:

- a) measure the significant dimension x_{emas} of the object with standard density
- b) angular displacement of the turntable to bring the standard density object $emas$ into an intermediate position in which it is gripped by the gripping arm
- c) position the object $emas$ on the irradiation support
- d) actual adjustment of the position of the irradiation support with respect to the source - detector assembly:
 - d-1) progressive displacement of the irradiation support along the Z direction between the predetermined positions $Z(1)$ and $Z(N)$
 - d-2) for each position $Z(i)$, irradiation of the object $emas$ by the photon beam M times, and obtain attenuated intensity values $I(i,j)$
 $i=1, \dots, N$ = number of positions $Z(i)$ between $Z(1)$ and $Z(N)$
 $j=1, \dots, M$ = number of irradiations for each position $Z(i)$
 - d-3) calculate the optimum position Z_{OPT} of the irradiation support from the positions $Z(i)$ and attenuated intensities $I(i,j)$
- e) return transport of the object $emas$ on the turntable.

FIGURE 11

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Step 3

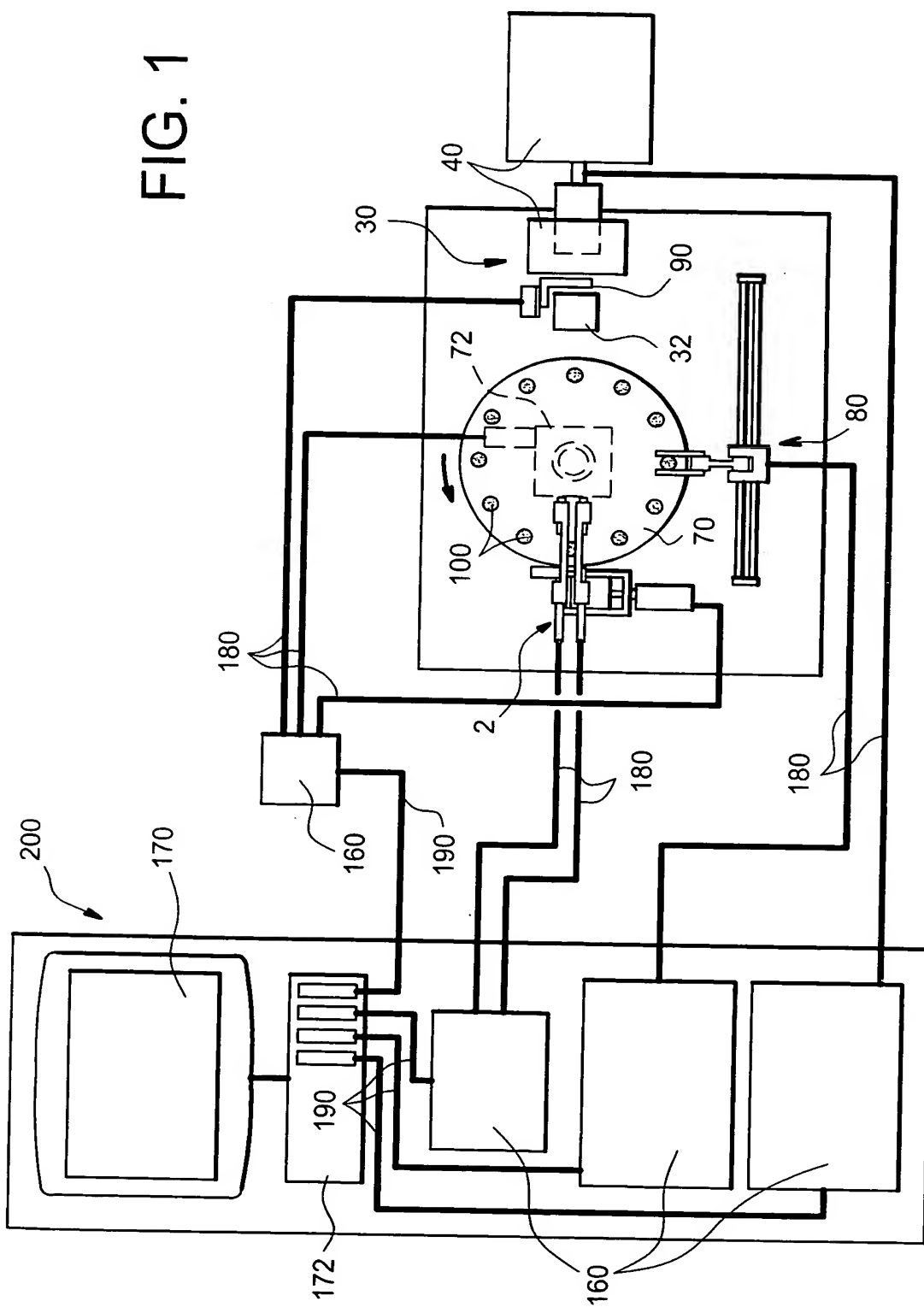
a) measure the photon intensity I_{emas} attenuated by passing through a standard density object $emas$ used as a reference

b) calculate the mass attenuation coefficient μ_m of the standard density object using the following relation:

$$\rho_{emas} = -\frac{1}{\mu_m x_{emas}} \cdot L_n \frac{I_{emas}}{I_o}$$

FIGURE 12

FIG. 1



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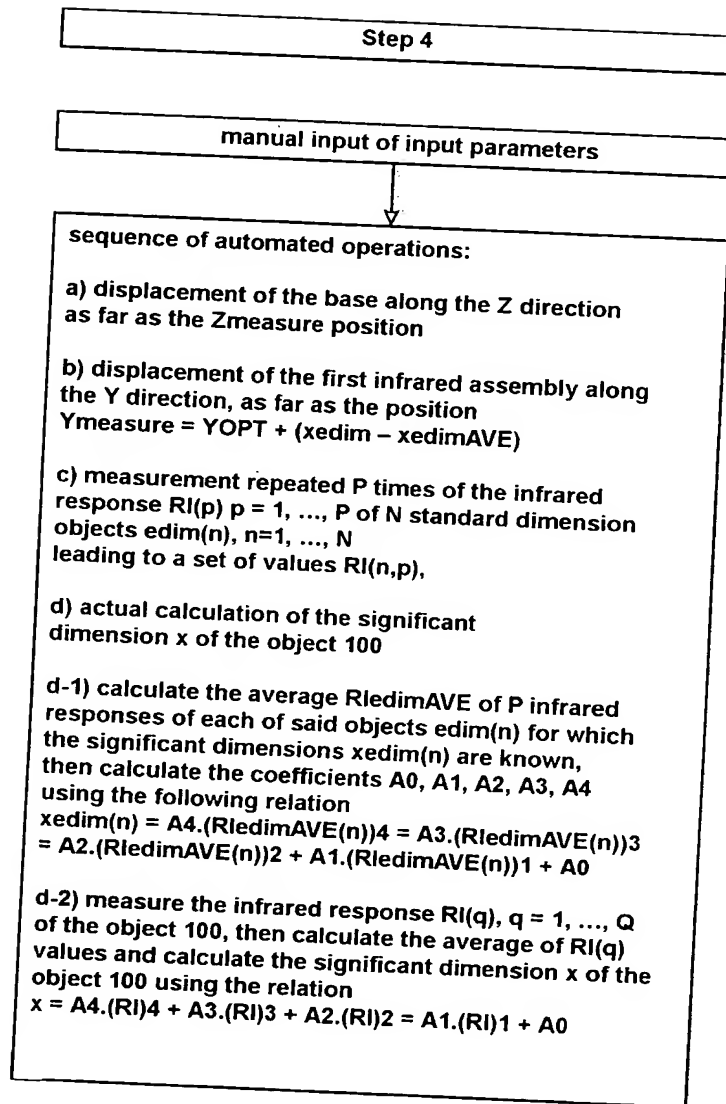


FIGURE 13

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Step 9

automated calculation of the relative variation $\frac{\Delta\rho}{\rho}$
of the density of the object 100 with respect
to the density of one or several standard density
object(s) emas using the following relation:

$$\frac{\Delta\rho}{\rho} = \frac{x_{emas}}{x} \left[1 - \frac{L_n \frac{I}{I_{emas}}}{\mu_m \rho_{emas} x_{emas}} \right]$$

FIGURE 14